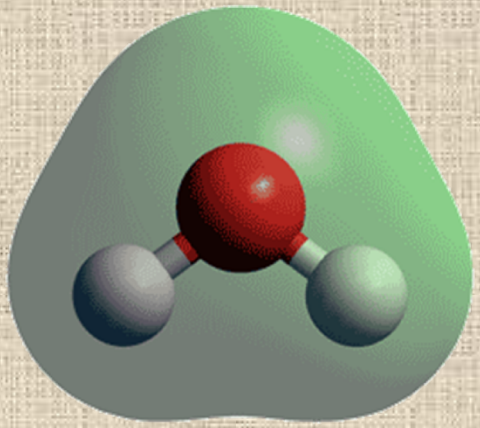
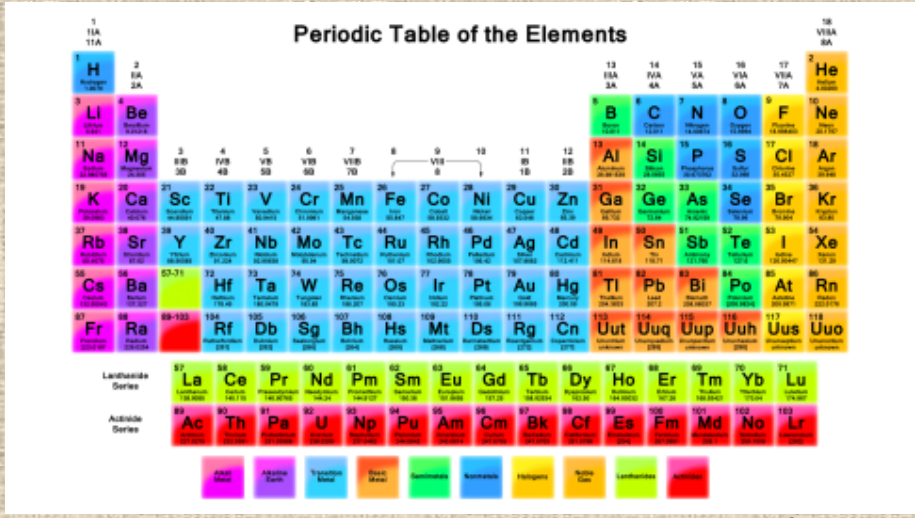
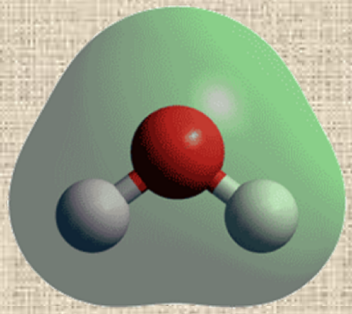


Energy Matters

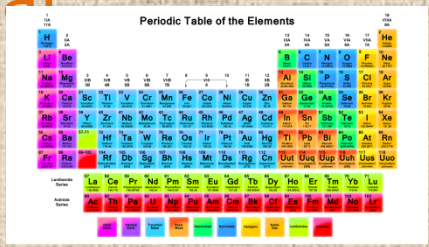
NCSO Coaches Clinic 2018

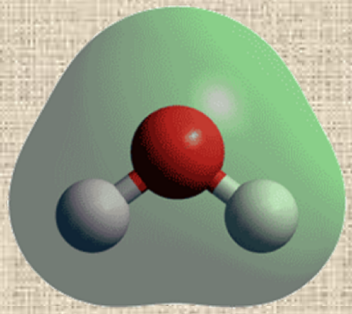




Welcome!
What is **Energy Matters**?

- Two-person team event
  - May have only one person, but it will be harder due to time restrictions
- Chemistry event
- Format has an experimental portion
- Must bring: writing instruments and goggles
- No other resources allowed
- **THE COMPETITION**: This event will be run in a station format. Typically 2 min will be allowed per station, with 20 min at an experimental station.

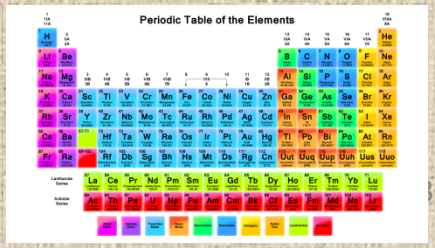


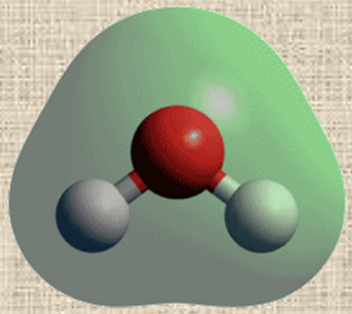


Scoring

- ◇ High team score wins
- ◇ Tie-breakers will be pre-determined questions

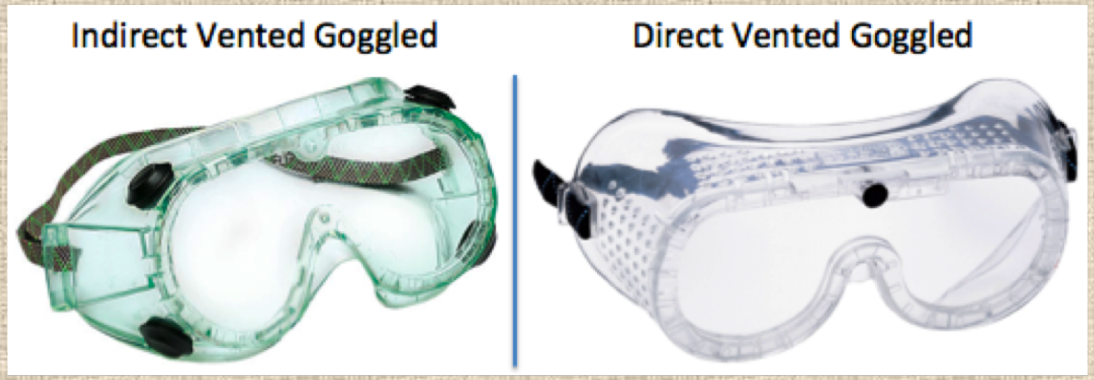
- ★ Spirit Award behavior
  - ○ sharing materials in need, kindness to others, thanks to volunteers, diligence in following directions, etc.





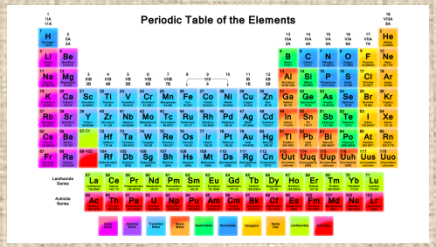
Safety

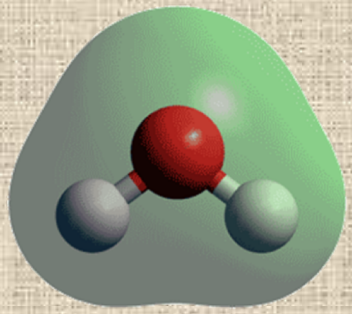
- Safety is our number 1 priority!
- Appropriate clothing: indirect-vent goggles needed for lab portion



- Remind students not to touch anything until testing begins
- No food, gum, or drink allowed in the lab
- No tasting samples

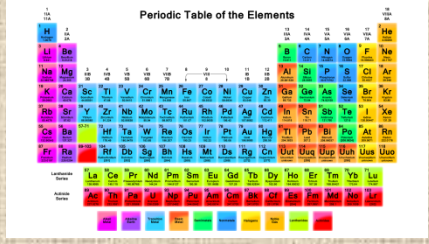
If students fail to follow safety procedures, they may be Disqualified

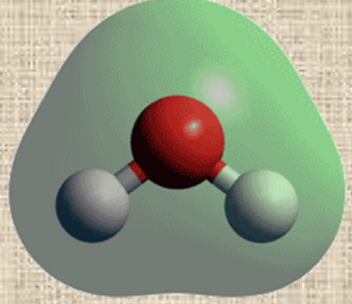




Safety continued …

- Goggles MORE:
  - Must be worn at designated stations
    - Regardless of activity, even if only writing
    - Keep goggles on until they get to the designated safe zone to defog goggles

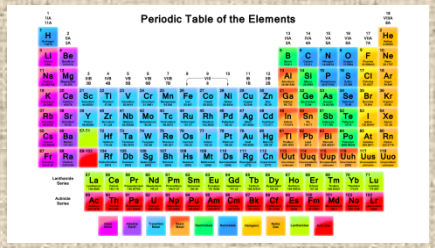


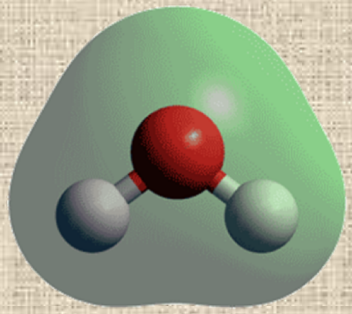


Energy Matters

DESCRIPTION: Teams will be assessed on their knowledge of:

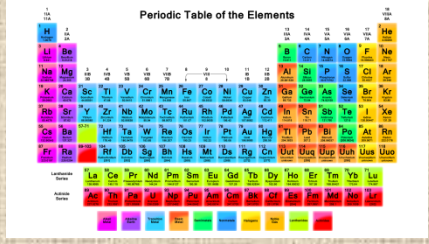
- the physical properties of matter
- the behavior of solids, liquids, and gases before and after they undergo changes or interactions
- energy forms
- transfer of energy, physical changes
- changes in states of matter due to heating and cooling





Lab possibilities

- May do an experiment or watch a demonstration
- Stations in rotation, so time is limited
  - Use time wisely - split duties



Sample question

- How do you recycle plastic bags?
- Why?
- Would you burn plastics and trash to dispose of them? YES or NO
- Would you burn them in your back yard? YES or NO
- Could they be burned in a large plant to create heat or electricity? YES or NO
- Why would you want to?
- Why would you not want to?

Sample question & answer

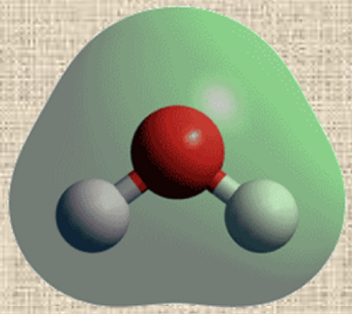
- How do you recycle plastic bags?
  - Put them in special containers at super markets
- Why?
  - They fly around and make a mess at recycling facilities, getting caught in the equipment
- Would you burn plastics and trash to dispose of them?
  - You can
- Would you burn them in your back yard?
  - NO
- Could they be burned in a large plant to create heat or electricity?
  - YES
- Why would you want to?
  - To dispose of them and keep them out of the landfills; to create heat and electricity
- Why would you not want to?
  - The gas that comes off is CO_2 and many pollutants; it is not clean and cannot be called renewable

Sample question

- Why does wood float on water?
  - A. It is more dense than water
  - B. It is less dense than water
- Why do people float in water? What about sea water?
- If you put salad oil and water in a container, what happens? Suppose you were to add mercury?
  - A. Top to bottom: oil, mercury, water
  - B. Top to bottom: water, mercury, oil
  - C. Top to bottom: oil, water, mercury
- Why does an iron boat float?
- Would that amount of iron in a block float? YES or NO

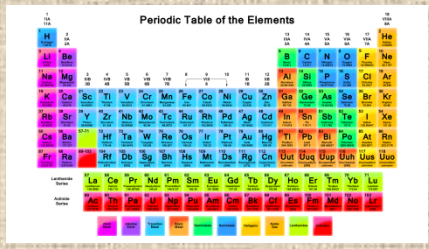
Sample question and answer

- Why does wood float on water?
  - B. Wood is less dense than water
- Why do people float in water? What about sea water?
  - People are mostly water, but the fat in most people makes them float, usually very close to the surface. Sea water is denser, so they float higher.
- If you put salad oil and water in a container, what happens? Suppose you were to add mercury?
  - C. Oil is less dense than water, so it comes to the top. Mercury is very dense, so it would be at the bottom.
- Why does an iron boat float?
  - It is hollowed out so that the volume of water that it displaces is greater than its mass. If you let some of that water in through a leak, it will rest lower and lower and then sink.
- Would that amount of iron in a block float? YES or NO
  - NO



Experimental Topics

- Working with atomic and molecular size ideas
- Solids, liquids, and gases: relative densities, shapes, volumes
- Energy comparisons by source, efficiency of production
- Energy : Renewable, cost, transmission from place to place
- Plastics comparisons
- Solutions and mixtures – are changes physical or chemical?
- Rate of reaction
- Physical or chemical change determination
- Basic forms of energy and how they travel: electrical, heat, light, magnetic, and sound.
- Transfer of energy from one object to another
- Analyzing data



Methocel demo

- Principle – change of state with heating and cooling
- Materials
  - Methocel tube
  - Glass of warm water
  - Glass of cold water
- Method
  - Observe the tube in the cold water
  - Put the tube in the warm water
  - Observe the result
  - Repeat to see what happens

Methocel 2

- How does this result match what you think would happen?
- Is the change physical or chemical? Why do you think so?
- Is body heat a form of energy?
- Where does it come from?
- What is in the tube?

Methocel 3

METHOCEL™ cellulose ethers are water-soluble methylcellulose and hydroxypropyl methylcellulose polymers. They're derived from pine pulp, the most abundant polymer in nature, and used as thickeners, binders, film-formers and for water-retention. They also function as suspension aids, protective colloids and emulsifiers.

Density Demo

- Principle: How density affects suspension in water
- Resources
  - Dish pan to hold water and objects
  - Test objects: cubes of iron wood, birch wood, balsa wood, and pumice
- Experiment
  - Place the test objects in the water
  - Observe what happens

Density 2

- Density : Mass per unit volume
- Results
  - Explain what you saw.
  - Does this confirm your guesses?
  - What does this demonstrate?

Density - 3

- Conclusion

The objects all have different densities. They displace a different amount of water based on their density, not the size or weight alone.

- Extra questions:
  - What would happen if you had an iron cube that had been hollowed out? Think about a boat? Does it float? It's made of iron, but it floats.

Marshmallows and Molecules

- Principle: Use the 6 numbered plastics to illustrate some molecules and recycling ideas
- Materials
  - Examples of as many of the 6 plastics as you can collect: water bottles, liquid soap jug, drain pipe, plastic bag, squeeze bottle, foam cup/clam shell with the number showing if possible

Marshmallows 2

- Which of these do you use every day?
- Which would you throw away every day (or put in the proper recycling bin)?
- Which would you want to be biodegradable – they would not last forever in the garbage dump?
- Which should NOT be degradable, if possible?
- Which are in between?

Marshmallows 3

List of the various plastics use produced/recycled

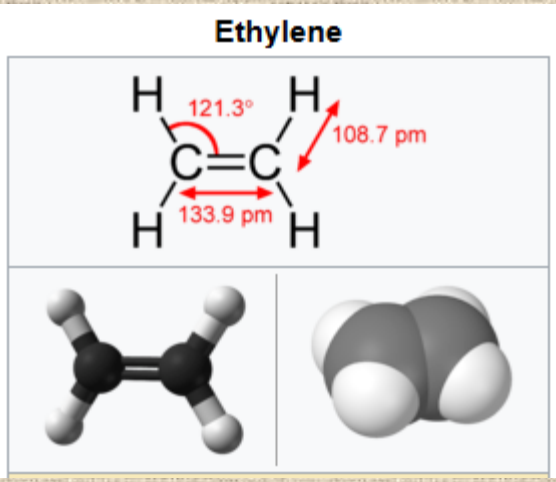
- 1 – PET poly (ethylene terephthalate) water bottles 4.5 BKg/19.5%
- 2 – HDPE high-density polyethylene liquid soap containers 5.5 BKg/ 10.3%
- 3 – PVC poly (vinyl chloride) water and drain pipe 0.9 BKg / 0.0%
- 4 – LDPE low-density polyethylene plastic bags 7.4 BKg / 5.3%
- 5 – PP polypropylene squeeze bottles 7.2 BKg / 0.6%
- 6 – PS polystyrene foam cups and clam shells 2.2 BKg / 0.9%
- Does this make sense? Why? Discuss this to bring out points such as plastic bags could be recycled more – they have to be special because they cause a huge problem to the recycling centers by clogging their equipment. Do you want drain pipe to degrade?

Marshmallows 4

- Principle: Making models of molecules with marshmallows
- Resources
  - Sizes of marshmallows, colors of marshmallows
  - Toothpicks
  - What do you want to build?
- .

Marshmallows 5

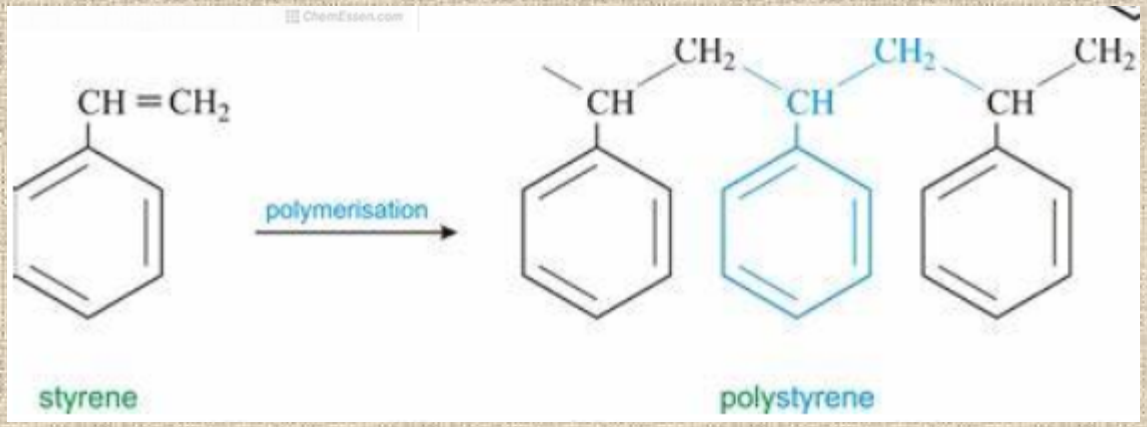
- Plastics 2 and 4 are polyethylene
- Ethylene is



- Take larger marshmallow for C's, 2 toothpicks for double bond, and small marshmallows for H's, and 1 toothpick to attach the H's .

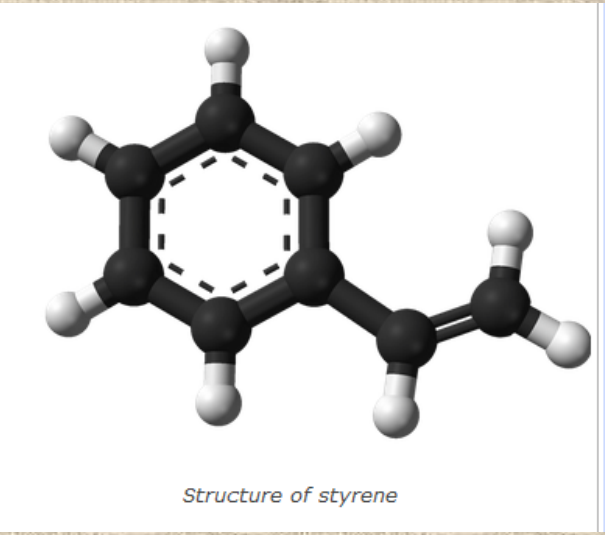
Marshmallows 6

- Try styrene
- The rings are made of carbons with 1 H on each corner



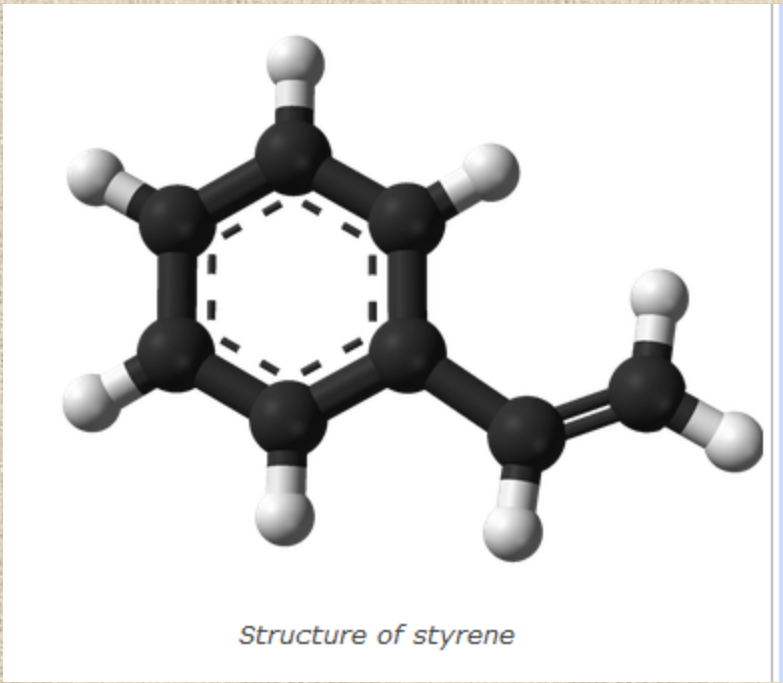
Marshmallows 7

- Use large marshmallows for C's and small ones for H's; use striped toothpicks in the ring and unstriped to attach small marshmallows for H's.
- As you can see in the reaction, the H's are where the styrenes join to make polystyrene.



Structure of styrene

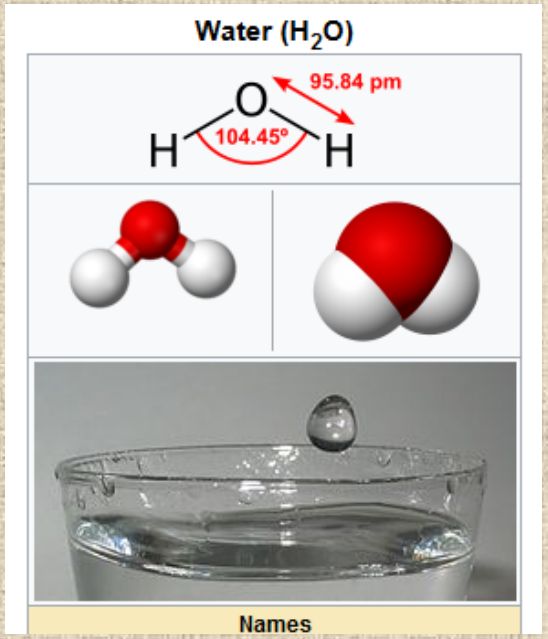
Marshmallows 8

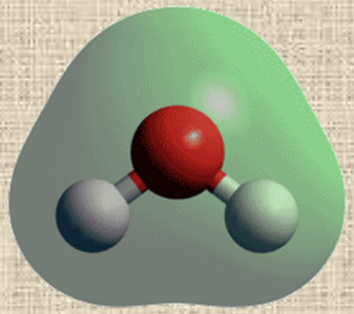


Structure of styrene

Marshmallows 9

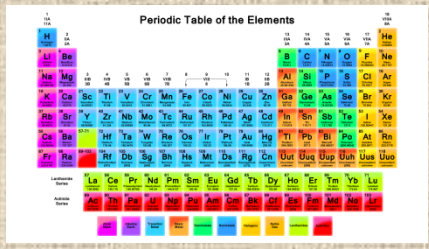
- Structure of water
- H_2O
- Use a large marshmallow for the Oxygen and 2 small marshmallows for the H's. Attach them with toothpicks – the angle between the H's is 104 degrees.





Static Electricity Demo

- Static electricity “snowstorm”
- Styrofoam pellets inside a plastic globe show attraction and repulsion caused by static electricity
- Unlike charges attract; like charge repel
- Materials
  - Glass globe - Will this work with glass???
  - Styrofoam balls – use paper funnel
  - Collection of cloth pieces to rub globe



Static Electricity Demo - 2

- Put styrofoam balls in the globe with paper funnel; close up the globe – those balls are tricky

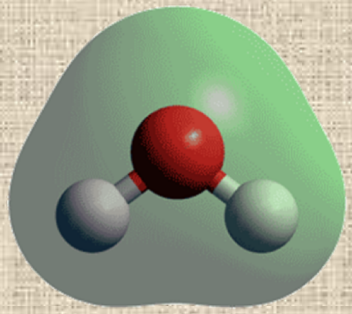
Static Electricity Demo -3

- Experiments
  - Shake the globe or rub it with your hand
    - What do you see? Develop words to describe it.
  - Rub the globe with the various fabrics
    - Do some produce stronger results?
    - How does your hand affect the balls? What about your elbow?
- Real life observations
  - Lightning – discharging static electricity from cloud to cloud or cloud to ground
  - Wintertime static electricity – sparks when you take off winter clothes or get out of the car

Static Electricity Demo - 4

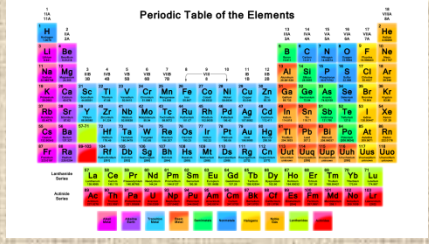
- Conclusions
  - Rubbed objects and materials become oppositely charged.
  - Fuzzy fabric and styrofoam balls are especially susceptable to static charging
  - The charge on the outside attracts the balls of opposite charge on the inside

  Question: How might this be harnessed? Is lightning in the sky useful? How?



Conclusion

- Safety is paramount
- Students benefit by being prepared for this event
- Must bring proper goggles and a writing tool
- Chemistry is FUN!



Energy

- Principle: discuss sources and forms of energy, talk about transmission, whether the energy is created with chemical or physical changes, uses in everyday life
- Ask: Are these forms of energy renewable? What does renewable mean? How might their production harm nature?
- Ask: Storage – how is energy stored?

Energy 2

- Solar energy
  - What causes it?
  - How is it absorbed?
  - Plants, warming the land and all of us, sunburn, solar panels to create ….. Electricity, warm water, Example:Davidson Co Solar Farm
  - Secondary effects
    - Wind
    - Evaporation, rain, …

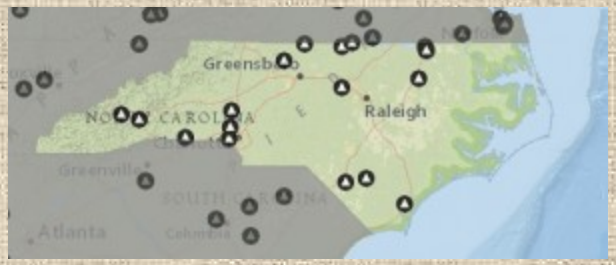
Energy 3

- Physical production of energy
  - Falling water – how did it get up so it could fall?
  - Dams: Apalachia, Chatuge, Cheoah, Cowans Ford, Fontana, Hiwassee, Santeetlah, Tuckertown
  - Rivers dammed: Hiwassee, Little Tennessee, Yadkin
  - Wind vanes
  - Ocean tides
  - Waves

Experimental NASA wind turbine on Howard's Knob in Boone (1978-1983)

Energy 5

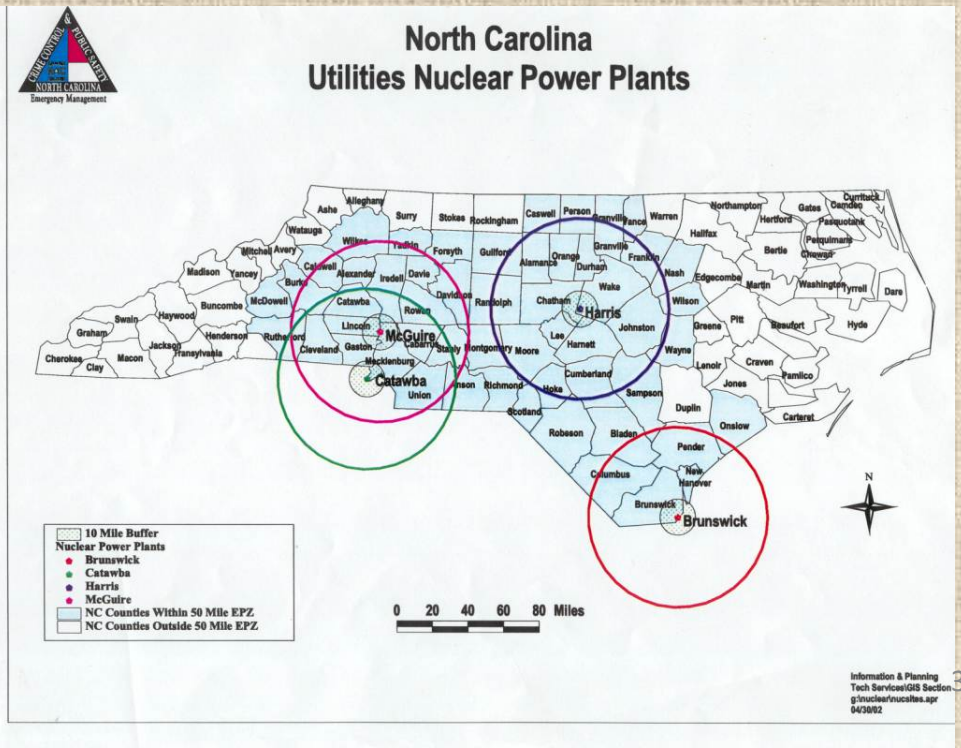
- Chemical production of energy – where do these come from?
  - Burning coal -37% of US Electricity: In NC:GG Allen, Belews Creek, Marshall, Roxboro



  - Burning gas in NC: Buck Steam, Dan River Steam, HF Lee, Riverbend
  - Burning oil
  - Burning waste, biodiesel
  - Burning wood – mostly domestic

Energy 6

- Nuclear energy
  - Where does nuclear energy come from?
  - Are there mines?
  - How many of these do we have in North Carolina or close by?
    - Brunswick
    - Shearon Harris
    - McGuire
    - Catawba in SC



Energy 7

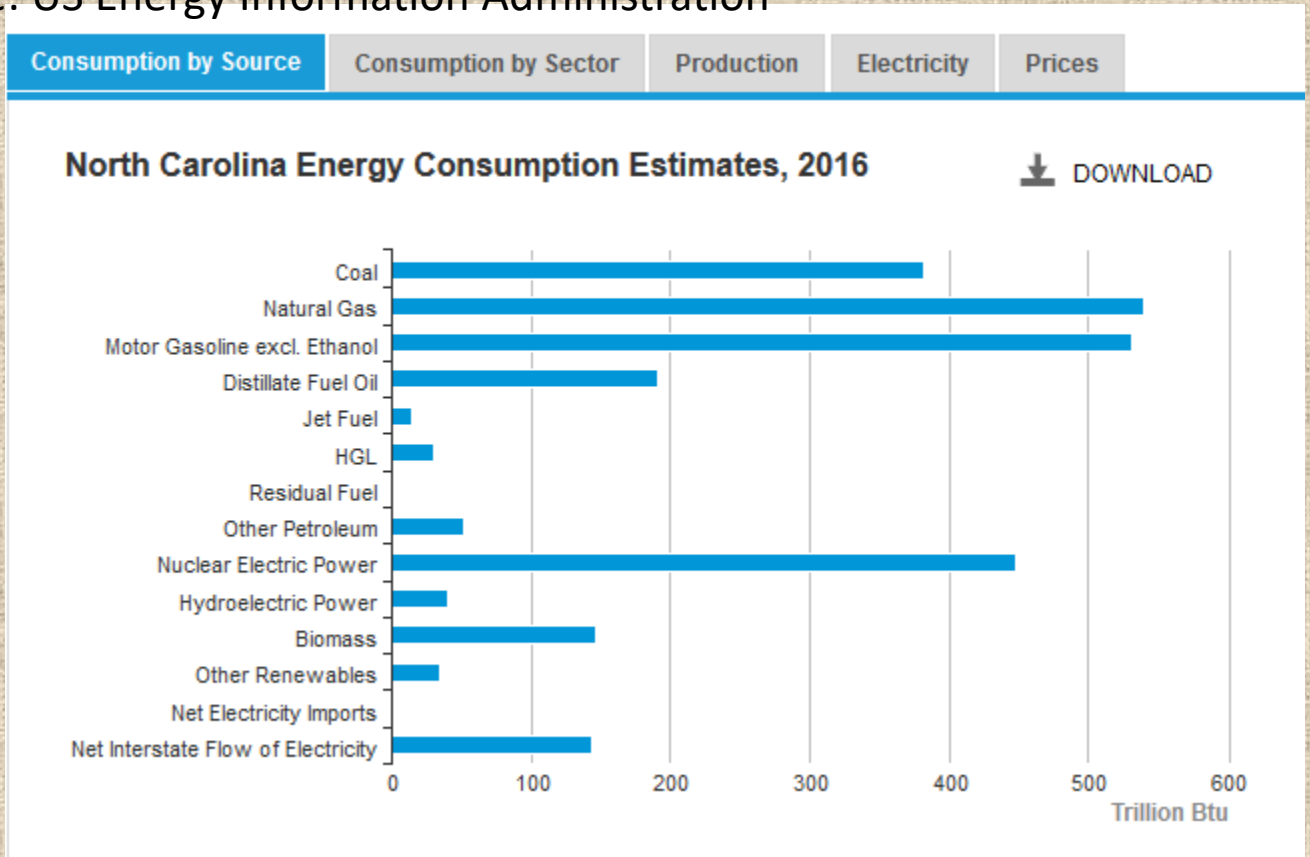
- Purposes of production
  - Vehicle propulsion
  - Residential uses
    - Heating and air conditioning
    - Light
    - Cooking, clothes washing, drying, ironing
    - TV, Computer, …
  - Manufacturing
  - Commercial operations

Energy 8

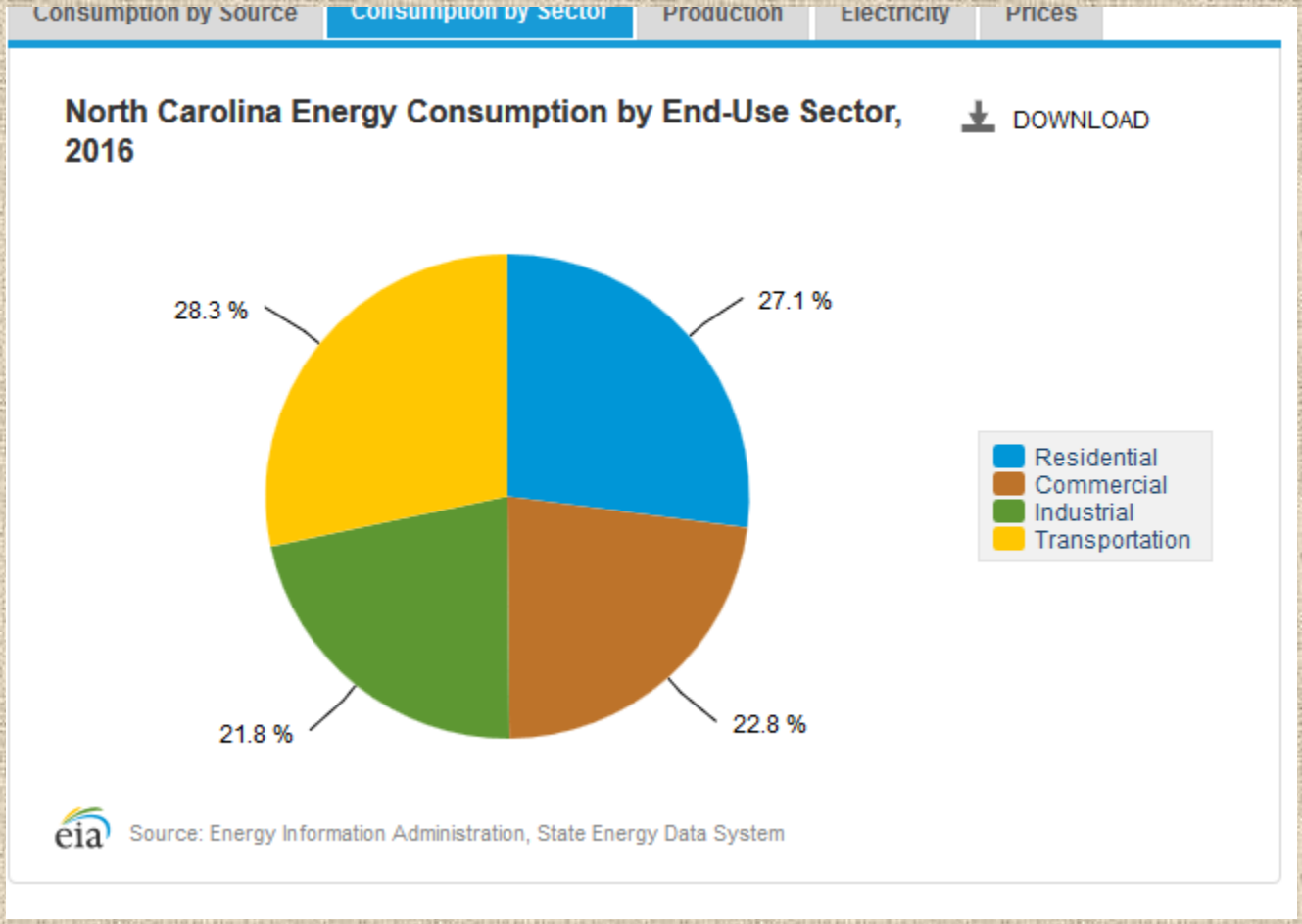
- **Quick Facts**
- In 2017, North Carolina ranked second, after California, in the amount of installed solar power generating capacity with over 4,400 megawatts.
- North Carolina's three biodiesel plants have a combined production capacity of 16 million gallons a year.
- North Carolina was third among the states in net electricity generation from nuclear power in 2017, producing nearly 7% of the nation's total.
- Nuclear energy contributed the largest share of North Carolina's 2017 electricity generation at 32%. Natural gas-fired generation accounted for 30%, coal was 26%, and renewables were 10%.
- North Carolina is home to the Southeast's largest wind farm, which came online in 2017 and has a generating capacity of 208 megawatts from 104 tall turbines.

Energy 9

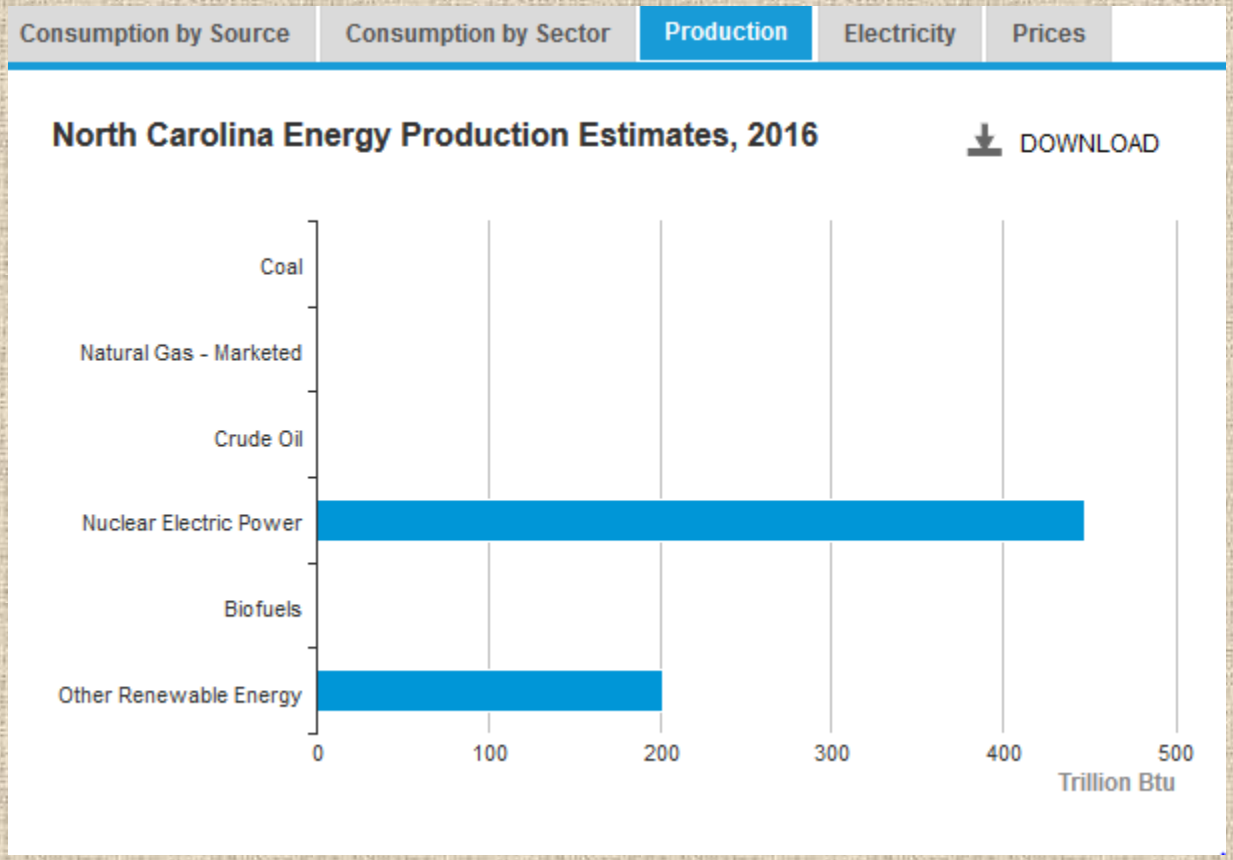
Source: US Energy Information Administration



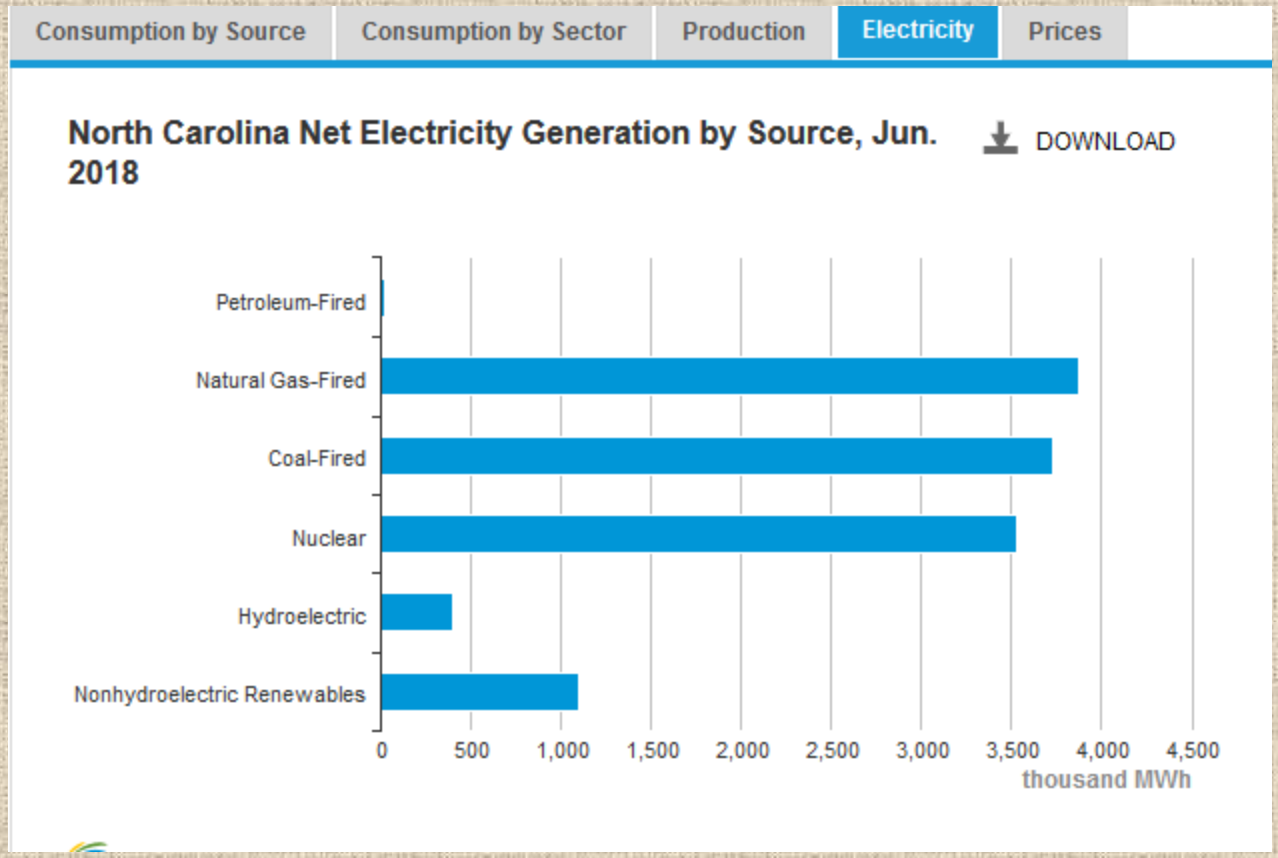
Energy 10


Consumption by Source
Consumption by Sector
Production
Electricity
Prices
North Carolina Energy Consumption by End-Use Sector, 2016
DOWNLOAD
28.3 %
27.1 %
21.8 %
22.8 %
Residential
Commercial
Industrial
Transportation
eia
Source: Energy Information Administration, State Energy Data System

Energy 11


Consumption by Source
Consumption by Sector
Production
Electricity
Prices
North Carolina Energy Production Estimates, 2016
DOWNLOAD
Coal
Natural Gas - Marketed
Crude Oil
Nuclear Electric Power
Biofuels
Other Renewable Energy
0
100
200
300
400
500
Trillion Btu

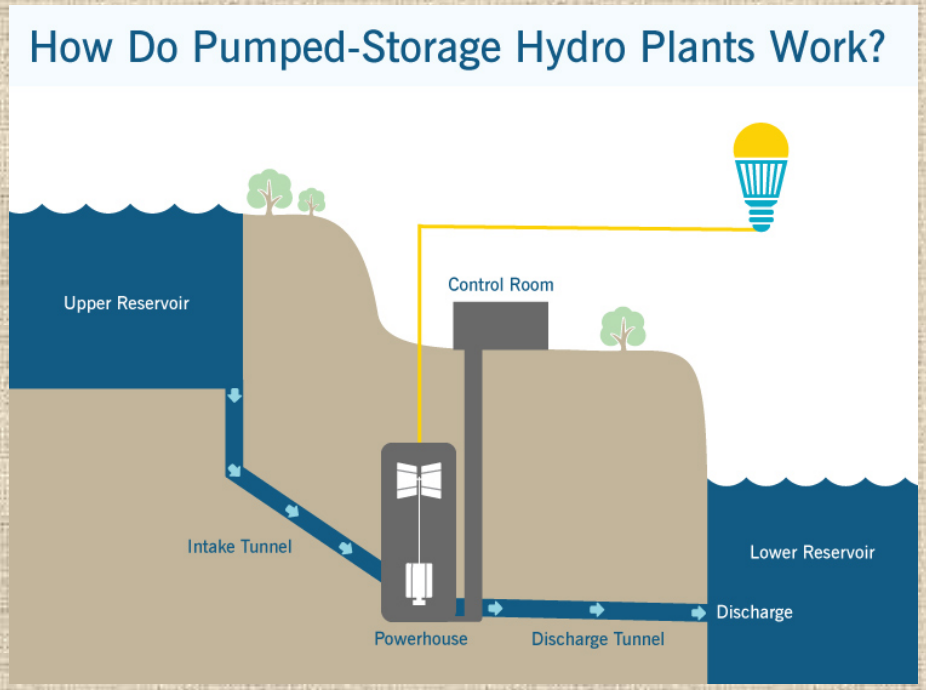
Energy 12


Consumption by Source
Consumption by Sector
Production
Electricity
Prices
North Carolina Net Electricity Generation by Source, Jun. 2018
DOWNLOAD
Petroleum-Fired
Natural Gas-Fired
Coal-Fired
Nuclear
Hydroelectric
Nonhydroelectric Renewables
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
thousand MWh

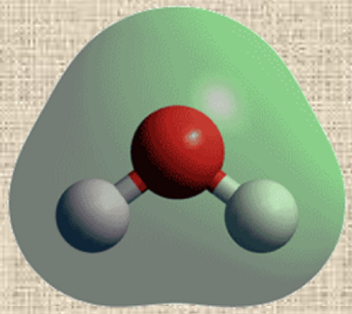
Energy 13

- Storage of energy
  - How do we store energy once we have created it?
  - Can we make it back into coal? Do we want to?
  - Batteries – how big can these be? Is the typical battery chemical or physical?
  - Pumped storage – pump the water back up into the dams – is this a good idea? Is this chemical or physical?

Energy 14



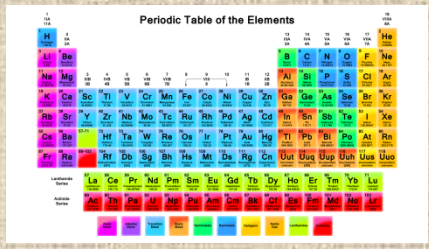
To make power the upper reservoir water turns the turbines in the power house; to store power, the turbines pump the water back up from the lower reservoir. The difference from the usual hydro plant: this one has a lower reservoir at the bottom, not a river. This a great BIG battery!!

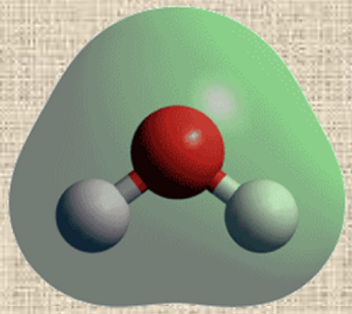


Resources

- Demo 1 Methocel
- Demo 2 Density
- Demo 3 Static Electricity
- Demo 4 Marshmallows and Plastics

- Wikipedia
- Google





Thanks for attending

Further questions may be addressed to:

- Barbara Croft at croftb@nc.rr.com
- Wendy Cook at wcook@sttimothys.org

- Remember to _____